

REQUEST FOR RECONSIDERATION

Claims 4-5, 7, 12-13, 20, 24-28 and 33-38 are pending in this application. Claims 4, 5, 12, 13, 20, 24, 25, 26 and 33 are independent. Claims 4-5, 7, 12-13, 24-28 and 33-38 are withdrawn from consideration pursuant to two Restriction Requirements.

The present invention provides an apparatus for the formation of a metal film. The apparatus comprises (i) precursor feeding means for producing a precursor, (ii) reducing gas heating means for producing an atomic reducing gas between a substrate and the precursor feeding means, and (iii) chamber heating means for heating an inner wall of the chamber to a predetermined temperature. The precursor is not allowed to deposit on the heated inner wall of the chamber. As illustrated in the specification at Fig. 16, precursor (Cu_xCl_y) 230 adhering to the sidewall of chamber 201 is readily vaporized, because the sidewall of chamber 201 is heated to a predetermined temperature (e.g., 200°C) by heater 228. Thus, precursor (Cu_xCl_y) 230 is prevented from depositing on the sidewall of chamber 201. Precursor (Cu_xCl_y) 230 passing through atomic reducing gas 251 is reduced into Cu ions, which are deposited on the surface of substrate 212, without heating the substrate appreciably. See, specification at page 70, line 12 to page 71, line 7.

Claim 20 is rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,091,209 ("Claverie") taken in view of JP 60-116776 ("Inoue"), U.S. Patent No. 6,440,494 ("Arena-Foster") and U.S. Patent No. 6,001,172 ("Bhandari"), and taken in further view of U.S. Patent No. 4,796,562 ("Brors") and U.S. Patent No. 5,273,588 ("Foster").

Claverie discloses a low temperature chemical vapor deposition process in which a gas stream containing a copper halide is reacted with hydrogen, activated by a heated catalytic metal filament, to deposit a copper film on a substrate. Claverie at abstract.

The Final Rejection at page 3, lines 1-2, admits that Claverie "does not discuss the use of chamber heating means for heating an inner wall of the chamber to a predetermined

temperature as recited in claim 20". The Final Rejection relies upon Brors and Foster for suggesting this limitation.

However, there is no motivation to combine Brors and Foster with Claverie.

Brors discloses a rapid thermal chuck to rapidly heat wafers to high temperatures in a chemical vapor deposition (CVD) system. Brors at column 3, lines 15-17. Brors discloses a CVD apparatus 10 including a deposition chamber 16 having a water cooling channel 17 in the outer walls "to reduce reactions at the walls". Brors at column 6, lines 27-29.

The walls of the deposition chamber 16 are water-cooled both to prevent gas phase reactions and to prevent deposition on the chamber walls which can result in particulate contamination. ...

In most processes there is a maximum temperature above which deposition takes place. There is also a minimum temperature below which one of the process gases will condense on the walls of the apparatus. Thus, the temperature of the reaction chamber and the mixing chamber must be regulated to be between the deposition temperature and the condensation temperature. The cooling water system must thus have means for either heating or cooling the water as conditions demand to stay within these bounds. Brors at column 8, lines 19-37.

In a chemical vapor deposition apparatus of the cold-wall type, one mode of operation is to injection two different reactive gases which must be completely mixed before these gases impinge on the heated workpiece. Brors at column 6, lines 4-7.

Foster discloses an apparatus primarily useful for the chemical vapor deposition of films onto semiconductor wafers. Foster at column 3, lines 31-33. Foster discloses

CVD processes such as those for the application of tungsten coatings to semiconductor wafers are typically performed in cold wall reactors, where the wafers to be coated are heated to a reaction temperature on a susceptor while other surfaces of the reactor are maintained at subreaction temperatures to prevent the deposition of films thereon. For tungsten CVD, for example, reactor walls are often cooled, often to about room temperature. Alternatively, for titanium nitride (TiN) CVD, the walls may be heated above room temperature, but to a temperature below that of the substrate being treated. Foster at column 2, lines 39-50.

In the preferred and illustrated embodiment, the susceptor is heated to approximated 400°- 550°C Foster at column 5, lines 38-39.

The reactant gases for the main CVD process to be performed with the reactor 15, in the preferred embodiment of the invention, are gases used for a blanket tungsten deposition process onto silicon semiconductor wafers These gases includes, for example, tungsten hexafluoride (WF_6), hydrogen (H_2), and silane (SiH_4). The reactor is, however, also useful for titanium nitride films and for many other films that can be applied through a CVD process. Foster at column 8, lines 46-56.

Thus, both Brors and Foster are directed to cold-wall CVD processes in which different reactant gases are mixed and reacted on a heated substrate. In contrast, Claverie and the present invention do not require heating the substrate to a deposition temperature. Claverie and the present invention are directed to processes in which a precursor (intermediate) is formed in a precursor feeding means and the precursor is then deposited onto a substrate by reducing the precursor between the precursor feeding means and the substrate.

Because Brors and Foster differ from Claverie in film forming techniques, Brors and Foster cannot be combined with Claverie.

Thus, the rejection of Claim 20 under 35 U.S.C. § 103(a) should be withdrawn.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Application No. 10/684,503
Reply to Final Rejection of May 26, 2006

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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